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Abstract

The desire to create a more competitive, market based transport system has led to the involvement of the private sector in infrastructure investments. A private financing of transport infrastructure is one of the fields where this trend can be recognised. However, there are also distinct aspects, which make it unattractive to invest in transport infrastructure for private parties. This paper will elucidate the characteristics of investments in infrastructure in general, with the aim to clarify the hesitation under private investors. In addition, one specific category of infrastructure investments, viz. container terminals, will be discussed here as an exception. Container terminals are mostly financed with involvement of private parties. From a comparative study between ' normal' investments in infrastructure and investments in container terminal infrastructure, we will argue that terminals have several features, which lead to a lower risk for private parties, in particular restricted competition in the terminal market and protected monopoly profits, labour productivity gains and fall in unit costs, and a light regulatory framework. Because of these characteristics public private partnerships occur rather often and seem to be attractive. However, without govemment support it is stil1 not realistic to attractprivate investment in the terminal market.

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1. Introduction

Transportation lies at the heart of the spatial-economie evolution of our economies (Nijkamp et al., 1995). A well-fùnctioning transport network is an important condition for the competitive position of regions and cities. Today, the most prosperous locations occur where transport nodes coincide with skilled labour locations and a high quality environment. This has encouraged some countries to take a more pro-active approach towards transport planning, with investment preceding rather than following demand. Seen from this perspective, infrastructure plays a fundamental role in the development of various regions. Investments in infrastructure are for many (local) governments a critical element of their policy. In a European context, investments in transport infrastructure are usually regarded as a major incentive for economic development, especially when one looks at the Trans European Network (TEN) plans.

The traditional approach in Europe to transport infrastructure has been based on detailed govemment intervention in the sector, ostensibly to protect the public interest (see also section 2). In the case of infrastructure direct state provision has been the norm (including financing). However, in recent years profound changes in economic and spatial policy have brought about a re-orientation so that the dominant role of the public sector is increasingly questioned. The trend towards market principles and liberalist views sketched by Fukuyama (1992), and mirrored amongst others in devolution principles such as deregulation, decentralisation and privatisation, has far reaching implications for public sector involvement in physical planning including infrastructure planning. An important background factor is the liberalisation of the transport market in the EU, not only for road but also for air, rail and waterway transport. These policy changes will have profound implications for financing European infrastructure (Henry, 1993). This trend is reinforced by developments such as public budget deficits in many countries and the need for more competitiveness in (semi) public goods delivery in order to enhance efficiency.

These developments have led to the desire to create a more competitive, market based transport sector in which the government does not need to fmance all investments in infrastructure. The debate has started to give the private sector a larger role, so that a more efficient operation of transport infrastructure is realised. But this process is not without problems and therefore not yet generally used throughout Europe. Especially in Western and Northem Europe experiences with privately financed infrastructure are limited. Private fmancing of transport infrastructure has been most significant in Latin America and the Caribbean region and in East Asia (World Bank, 1996). The present paper pays particular attention to the problems and possibilities in private fmancing. After outlining some of the characteristics and risks of private investment in infrastructure the focus will be on a particular kind of infiastructure; namely container terminals at (sea-)ports. A container terminal is a place where containers are transferred between any two or more freight transport modes. In this interface unit loads are collected, exchanged, stored and/or distributed. Private involvement in financing and operating container terminals in harbours is stated to be high compared with other investments in European transport infrastructure such as roads and railways (see e.g. Farrell, 1999). The aim of the present paper is to elucidate on this theme and to identify particular issues why terminals are to be attractive for private investors, based on a comparative study.

This paper is organised as follows. Section 2 will start with a genera1 description of the characteristics and risks of investments in transport infrastructure in general. This will reveal some of the unattractivities for private parties to invest in this type of infrastructure. Section 3 will elucidate on the state of the art in financing of terminals in Europe. Section 4 will focus this discussion on financing of terminals by describing a frequently observed type of cooperation via public private partnerships. In the final section some considerations and lessons regarding private financing and operation of infrastructure following from the terminal studies will be discussed.

2. The Nature of Investments in Infrastructure

Infrastructure is a broad concept. Several defmitions and descriptions have been used in the literature. Recently, a study on the meaning and content of this term has been carried out by Nijkamp et al., 2000. Following this study infrastructure includes those real estate provisions, which increase the efficiency of the use of production factors and meet the following requirements: infrastructure is directly productive, is characterised by stock features (capita1 good) and it has the character of a (semi-) public good (non-excludability and non-rivalness). Three categories of infiastructure can be distinguished. Physical network infi-astructure includes elements such as transport infiastructure and public utilities, water management and industrial sites and is relevant in our context. Immaterial knowledge infrastructure and environmental infiastructure are the two other categories. When we refer to infrastructure in this paper, we mean the first category and more in particular transport infi-astructure. Transport infrastructure consists of several aspects that are necessary to facilitate the movements of goods and passengers. Well-known examples include waterways, railways and road infrastructure, but also seaports, airports and telecommunication.

Traditional welfare theory argues that social welfare can be maximised through market transactions based on free exchange in perfectly operating markets. In this ideal economy government intervention would negatively affect the Pareto-optimal outcome. However, following the above-mentioned description, the market for infrastructure is not perfectly operating. There are market imperfections (e.g. imperfect competition, the existence of externalities) which make govemmental intervention necessary in this sector. The aim of the government is then to remedy this sub-optimal allocation and in this way to move towards the theoretically pure situation of perfect competition.

In recent years however, it has become understood that mainly due to govemment failures fmancing of all types of infrastructure by govemments is not an appropriate solution, and certainly not in a situation of high public sector deficits. Mistakes in this respect might result from imperfect insight into the real demand for public services and insufficient recognition of both positive and negative effects of policies. These failures of govemment agencies lead often to problematic cost estimates and in several cases to inefftcient spending of public money. Clearly, it is overly optimistic to think that these failures will completely vanish with private fmancing of infiastructure investments. However, from a fmancial point of view private involvement is attractive, as attention is focused on economic and commercial value. The basis for increasing economic sustainability in the transport sector is to create a competitive, market based transport system and thus to include the private sector. But the private sector is generally not highly interested in fmancing and operating transport infiastructure. In most cases this is caused by the characteristics and risks involved in infrastructure investments. In the sequel private involvement in infrastructure investments will briefly be discussed. Knowing this, the characteristics and risks for these types of investments will be investigated.

2.1 Options for private finance in transport

Private fmancing of construction is usually associated with continuing public sector responsibility for strategic network and locational planning. In the case of toll roads and urban mass transit infrastructure, private firms are normally given a concession to manage and operate the facility for a certain period, with ownership of the asset returning at some point to the public sector. The same holds true for investments in container terminals (see section 3 and 4). There are several ways in which the private sector can contribute to the transport system (ITS, 1999). Several examples of private contributions to financing, and of more far reaching private sector involvement are given below. In section 4.1 we apply these types of public private partnerships to the container terminal market with the help of the theoretical background of Dietrich (1994).

- A tax can be imposed on firms in a region; reflecting the broad transport benefits obtained by these firms or firms in a region; the French Versement is an example.

- A more focused charge can be levied reflecting the specific transport benefits obtained by a particular property; the US concept of value Capture is based on this principle.
- The private sector can be involved directly in financing new investment, as happens with many rail projects, with the operator of the infrastructure repaying the loan.
- The private sector can be involved in the operation, with the private sector operator obtaining its revenue directly from the user.

The first two of these have no direct effect on the specification of a transport strategy; besides, firms are only indirectly involved in financing (and not investing). But it may well help to make the strategy financially feasible for the public sector. The third introduces the impact of private sector objectives, which will emphasise a financial return on investment in the specific measures covered. The private sector may be more willing to invest in particular projects than others, and this could influence the formulation of the strategy. The last example introduces the implementation of charges on users, through fares, parking charges or road use charges. These charges will be determined in order to maximise revenue, and this can significantly affect the performance of the overall strategy. For example, higher fares designed to produce a return on investment in a new urban rail system may reduce patronage and hence the contribution to congestion relief and environmental protection will decrease.
The private sector usually seeks for commercial profit to be gained either as returns from investment interests, or as value Capture through improvements in the transport system. Despite the higher costs of capita1 raised from commercial sources and the need to cover the risks and gaining commercial profit, it has been argued that the overall cost for the community could be lower with private financing, than if the govemment would provide the facilities from taxation funds. The following objectives for private financing can be identified (ITS, 1999):

- Minimisation of the impact of additional taxation, debt burden or financial guarantees on the finances of the govemment
- Introduction of the benefits of private sector management and control techniques in the construction and operational phases of the projects (possibly leading to lower costs)
- Promotion of private entrepreneurial initiative and innovation in infrastructure projects
- Increase in the financial resources that might be available for the projects.

In container terminal investments especially the second and fourth objective for involvement of private container terminal operators do apply. Private fmance can be said to be only purely private if (ITS, 1999):

- The private party runs all risks, and
- The investment is paid directly by its users, and
- The operation is based upon user charges

In practice, transport infrastructure is rarely fulfilling these requirements. Almost all European transport infrastructure (except toll roads in France, Italy and Spain) has been financed and operated by govemments or by public organisations tied to the government. The backgrounds related to this high public involvement will be discussed in the next subsection.

2.2 Characteristics of investments in infrastructure

Investments in infrastructure have some special features. Broadly speaking one can identify seven characteristics of investments in infrastructure (ECMT, 1990 and Nijkamp et al., 1997). Firstly, the expectation of the *economic life of infrastructure* is very long. This may range from 20 years to more than a century. The pay-back period of infrastructure investments is also long; usually around 15 to 30 years. The pay-back period for normal capita1 goods is generally much shorter; the average is 8 to 9 years.
A second characteristic in many cases is the relatively *low level of the operational (variable) costs*, especially on longer distance infiastructure. There are some overhead, maintenance and labour costs, but compared to the construction costs of infiastructure or the exploitation costs of other investments, these costs are relatively low.

Thirdly, during the construction time, a ***large amount of capital*** is required. Often high loans have to be acquired, which makes the interest costs relatively high. The costs are also influenced by the project financier; the govemment is usually able to attract loans which are cheaper (i.e., lower interest rates) than the private sector.

Another feature of infiastructure investments is that the ***waiting period prior to actual infrastructure construction*** can be very long. This has to do with the many legal decision-making procedures, resistance by society and interest groups, and other time consuming formalities. These formalities often lead to project changes that have a major influence on the costs of projects. During this planning process different unforeseen facts may thus happen which are of critical influence on the whole project and may even lead to planning disasters (see Hall, 1990). In fact, this situation makes it very difficult to make a reliable and good cost estimation at the beginning of a project. Ideally, everything should be clear when the construction of the project starts, so that then a good estimation should be possible.

A fifth characteristic is the ***irreversibility of the investment*** once the project has started. If the construction is discontinued, this would lead to a significant capita1 loss, because it is not possible to use the investment in another way. In fact, once started, the project will be built if it is within the budget of the government. It is clear that the agency responsible for the project wants to finance it as soon as possible. One may safely assume that the costs of the project at that stage are as low as possible to ensure that the project will be executed. This suggests that the costs may be somewhat underestimated at the beginning of a project.

The next feature of infrastructural investments is the ***Zong construction period.*** This period may take two to seven years depending on the scale of the project. During this period there are no revenues, but there are of course already interest and other costs. This long construction period also makes it more difficult to offer a good cost estimate, as several extemal factors may influence the project during this period, one example being the rise in the price level.

The fmal characteristic is the ***uniqueness*** of each infrastructure project. Each infiastructure project is different from another. This fact will likely have an influence on the cost estimations, because of missing experience, low leaming possibilities and lack of comparability.

The above mentioned characteristics show that at the outset of a project high financial capita1 outlays are needed. This makes private investors more reluctant, because their flexibility tends to decline. The high costs at the beginning of a project are not immediately compensated for by high cash-flows. There are apparently many risks involved in infiastructure projects; these will be discussed in the next section.

2.3 Risks in infrastructure investments

The major issue in involving private finance for transport infiastructure investments concerns the sharing of risk. In infrastructure investments the flow of revenues often begins many years after the initial investment; this increases uncertainty and risk compared to altemative investment options. Investments in infiastructure incorporate various risks; the following classes may be distinguished (Nijkamp et al., 1995):

- politica1 risks; for example, changes in transport policy or regulations by the government;
- fmancial risks; for example, fluctuations in interest rates and exchange rates, and false expectations about inflation;
- construction risks; for example, delays, unexpected and higher or lower costs;
- operational risks; for example, damage by accidents and vandalism;
- commercial risks; for example, wrong cost estimates or wrong estimates of the traffic volume.

All these risks make it difficult to draw up a reliable cost and demand estimation, because each risk has its distinct influence on these variables; for example, a new law supporting

environmental protection. A policy shift may lead to the construction of a road tunnel to protect a natura1 area, whereas at the outset of the project, the road was scheduled to cross the area. This leads, of course, to higher costs that could never have been estimated at the start of the project. A clear example of commercial risks is formed by the Scandinavian bridge crossing the Sont where traffic was highly overestimated leading to disappointing toll revenues. In a later part of our paper we will come back to the risk problem and apply the different risk categories to container terminal investment projects (see section 4.1 and 4.3).
The construction costs (including interest costs) of infrastmcture are, up to a certain leve1 of demand, fixed; the other costs are partly fixed and partly variable. The fixed costs are very high for an investor when compared with competing investments, while variable and marginal costs are normally relatively low. When the price is set according to marginal costs (which is economically optimal), it is often not possible to make a satisfactory return on investment. The variable costs per volume of transport are for reasons of simplicity assumed to be constant, which is a rather plausible assumption as long as the capacity of infrastructure is sufftcient. As a consequence also the marginal costs are constant until there is a lack of capacity. From Figure 2.1 it becomes clear that price p_1 is economically optimal for an investor (this corresponds with the point where marginal revenues are equal to marginal costs). The total number of transported volume equals q, while total revenues correspond to the area $0qAp_1$. The total costs are equal to the area $0qBp_2$, leading to a loss of this project of area p_1p_2BA. In this case it is not possible to find a price at which the project is profitable, because fixed costs could not be covered from the revenues. It is now only possible to operate the infrastructure project at a profit, when extemal financing is obtained (from the govemment or other interested parties). The average total cost curve is then lower. When it is located below A, a profit will be made.

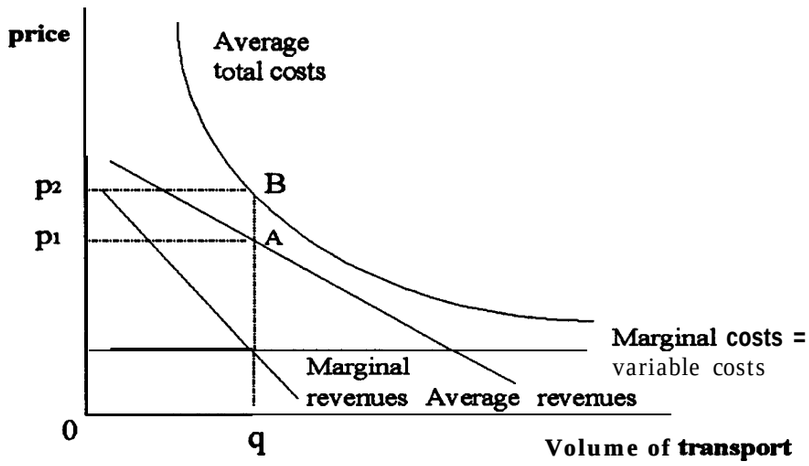

Figure 2.1: Market situation for an investor in infrastructure (Nijkamp et al., 1995)

From the aforementioned risks, the politica1 risks are the most pressing compared to other investments. The govemment has many reasons to interfere in the transport market. As mentioned earlier, there is on the long run always a danger of changes in laws or regulations, or there may even be a change of government and thus a change of transport policy.
In conclusion, because of the high risks of investments in infrastructure compared to other investment opportunities, these investments are often tmattractive for private investors. There must be a high-risk compensation for these private investors if they are to participate into these types of investments. This compensation may stem from high profit expectations, as is

shown by some road tunnel projects in the Netherlands. Another option is that govemments make these investments more attractive, if they do not want to finance these projects directly. They could do so by means of joint-risk constructions (guaranteeing a public subsidy if the use of infrastructure is below the expectations), or by guaranteeing a minimum profit ratio.
From the foregone the backgrounds of difficulties to attract private interest in the financing and investment of infrastructure projects have been clarified. However, there are some forms of inîiastructure where private involvement seems to occur more often. The telecommunication sector may be one example, another is related to infrastructure in (sea-)ports. The next section will analyse investments in a specific segment of ports, namely container terminals. It is interesting to analyse why such terminals are more interesting investment objects compared to other transport infrastructure.

3 Container terminal investment: European state of the art

3.1 Investments in ports in general

Containerisation has led to the development of increasingly bigger and bigger vessels, while maritime competition has resulted in the formation of alliances of container carriers. This development has forced port authorities and container terminal operators to increase their scale as well. The location of individual ports is rapidly becoming less important in favour of the extent to which its services and hinterland connections fit into the alliance networks (See also van Klink, 1995). In the past decades, reputations and businesses of European ports were primarily built on their locations in protected harbours, near major rivers or with access to industrial centres. However, networking -rather than location- seems the key to future growth of ports. Furthermore, the volumes per alliance are enormous and will probably result in single user container terminals and in the medium term maybe even in single-user container networks.
Ports are rapidly becoming a normal industry through the injection of private money that ensures greater competition, higher productivity and probably lower costs. The transformation process of the last two decades, which few other industries can match, has been one of the main drivers of this development. In Europe, the UK is at the forefront of these developments. Recently, mainland Europe is catching up as govemments loosen their grip on ports and container terminals. Ports are becoming landlords and lease container facilities to private companies. Even port authorities are linking up. More consolidation is to follow with the UK and Germany leading the way. The most notable exception in this process is France. So far, the benefits of private involvement in ports are strictly limited to container terminals. Ports - and especially container terminals - have become a real business and money from conglomerates and aggressive equity funds is flowing in. Until very recently, politica1 interference and the structure of port management has not changed to meet the new circumstances, but markets are changing. Ports are stil1 politica1 business, except for the UK where the industry is almost completely privatised.
In Figure 3.1 we have depicted the actors and their relations with respect to investment in container terminals in general. In Northem European landlord ports the most common financial structure is one in which the government pays for access to the port by land and sea, an (autonomous) port authority funds infrastructure such as land reclamation and quay walls, and private container terminal operators fund the suprastructure: paving, buildings and mechanica1 equipment. Infrastructure costs are recovered to a greater or lesser extent through charges on ships and cargo, and rental and leasing payments from the container-handling companies. However, there remain large differences in the leve1 of public sector financial support, which are passed on into port tariffs. In southern Europe, port authorities and/or the state were until recently responsible for almost all port investment, including mechanica1 equipment and superstructure as well as inîiastructure. This was the result of vertical integration (Greece), the strength of the unions (Italy), the weak financial position of the private stevedores (Spain) or the treatment of ports as a public service (France). However, the

reforms of the early 1990s and the move towards landlord ports have resulted in a gradual convergence of financial structures in northem and southem Europe.

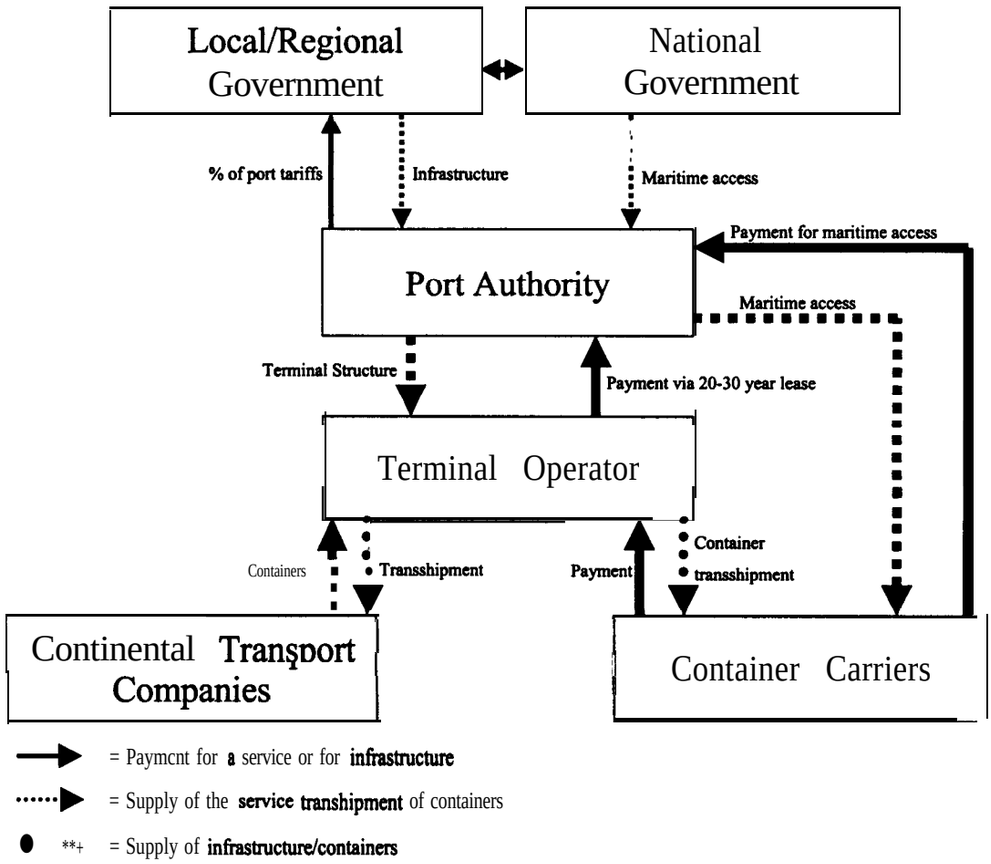

Figure 3.1: An overview of actors and relations in container terminal investment
Source: based on Wiegmans et al., 1999

It appears that private involvement in fmancing container terminals in harbours is high compared to other investments in transport infiastructure such as roads and railways. A possible explanation is that container terminal operations are too complex for cities and regions; another explanation for private involvement may be found in the increasing efficiency of privately run terminals. A third explanation may come from the increasing scale of container terminals and another part of the picture may be found in the fact that operating a container terminal is no longer considered as a core business of governments. Reasons for governments to be stil1 involved in container terminal investing are to be found in the creation of employment and also the fact that ensuring sufficient provision of infiastructure is sometimes stil1 considered as government core business.

3.2 Container Terminal Infrastructure Investments

Container terminals form a centra1 part of the transport infrastructure for freight transport. A terminal is a place where goods are transferred between any two or more freight transport modes and is often located at modal transfer points (such as harbours) (see also Wiegmans et al., 1999). In the terminal market we have two important groups: owners and operators:

1. terminal *owners* who are *not* providing the terminal services by themselves (investors). Basically, there are three forms of terminal ownership; privately owned, publicly owned, or a public/private partnership. Especially the third form of ownership can further complicate daily operations, because the actors often have conflicting interests;

2. terminal operators who provide the terminal service assortment. The terminal operation can be accomplished by a railway company, seaport company, shipping line, private company, consortium, independent regional operator, multimodal shipping companies/forwarders, road haulage industry, and/or even cities.

The aim of the terminal operator is to provide the customer with terminal services for the best possible price. Terminal service quality may be looked upon from three perspectives (Hilferink, 1994); i) customer-oriented; ii) network-oriented; iii) production-oriented. In this paper we concentrate on the production-oriented approach in order to find out the cost elements of a container terminal and to identify the difference between the financing of terminal infrastructure and inîiastructure in general. It is often claimed that costs per container handling generated by terminals are high. However, several genera1 indicators suggest that terminal service charges are not exceptionally expensive (Societa per Azioni, 1991, CBS, 1998):

1. The average financial results of terminal operators in genera1 (in the Netherlands) are not extremely high (average 5,1% of terminal sales)
2. The terminal handling may be expensive, but the total cost figure of the combined transport Channel as a whole is far more important. Therefore, it is more important to look at terminal service charges from a marketing channel perspective
3. The price/quality ratio per transhipment is not well balanced. Terminals may provide their customers with pre-defined quality levels and clear cost figures to justify their terminal handling prices.

As a starting point we use the table below in order to distinguish between the various cost elements of maritime container terminals. A container terminal can basically be developed in three ways: a new container terminal can be developed on a greenfield site, an existing container terminal can be extended, and an industrial site can be redeveloped into a container terminal. Furthermore, we distinguish between four different categories of terminal investments:

1. Infrastructure investments consist of investments in rail, road, barge and sea facilities to the terminal (terminal external).
2. Terminal structure investments consist of specific investments (e.g. quays, cranes, and crane rails) in terminal inîiastructure (terminal internal).
3. Investments in the terminal suprastructure are investments on the terminal site that are not specific for a container terminal (e.g. terminal buildings, pavements, lighting, etc.).
4. ITstructure investments are all information technology investments needed for the container terminal.

Table 3.1: Ways to develop a container terminal and investment categories

	New CT	Exteosion of CT	Redevelopment
Infrastructure	X	x	x
Terminal structure	X	x	X
Suprastructure	X	x	X
ITstructure	X	x	x

X = high importance in financial terms, x = average importance in financial terms

Source: Wiegmans et al., 1999

Due to lack of data it is not possible to provide exact insight into cost components of container terminals in genera1 (both continental and maritime). However, there is a study from TU Delft (1995) which provides some insight into the cost elements of very small container terminals (mostly continental terminals).

3.3 Investments in container terminals: characteristics and risks

In this subsection we combine the theory about investments in infiastructure (section 2) and the specific case of investments in container terminals. We pay particular attention to the rationale for public sector activity in container terminal investments in combination with interaction with private firms. According to Dietrich (1994) two important principles have had an important influence on economic perspectives on the public sector and its relationships with private sector activities. First, the two sectors are involved in separate activities with different responsibilities. Secondly, the public sector must restrict itself to developing a legal and economic infrastructure. As govemment activity is based on the power of the state, contacts can be either based on govemments determining infi-astructural conditions within which private actors operate autonomously, or contacts can be direct and interactive.

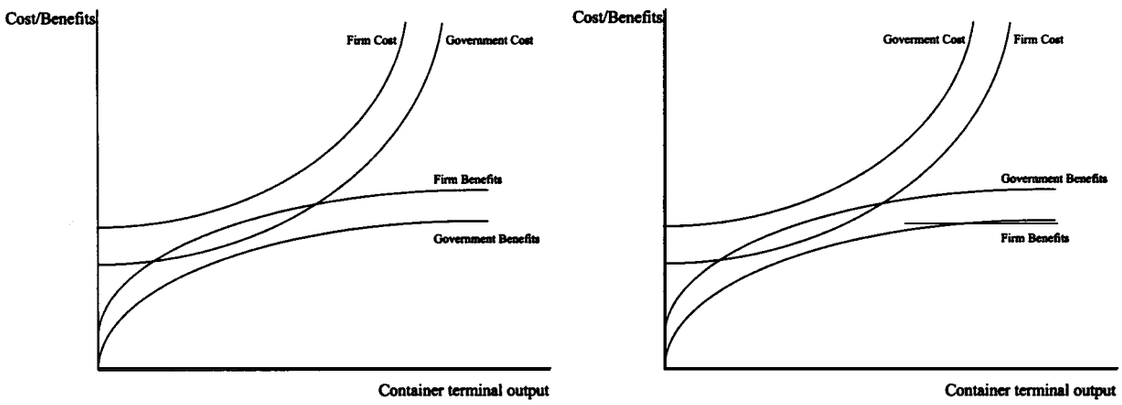

Figure 3.2: Cost and benefit relationships between govemments and firms
Source: Dietrich, 1994, adapted

In the left part of Figure 3.2 we observe that the govemment is more efficient in cost terms but the reverse holds for benefits. On the cost side private sector failures exist, perhaps because of the public good characteristics of the activity in question with resulting free-rider problems. This is the case in container terminal investment where especially access to terminals via road, rail and water carry public good characteristics. Also the fixed lease term means that container terminal operators are not willing to invest huge amounts in a container terminal that after the lease period can be contracted to another operator. In the right-hand part of Figure 3.2 we observe that from a cost perspective firms are more efficient indicating that the activity in question is readily marketable. Resource benefits however, indicate advantages of govemment activity. This might indicate the existence of private sector failures (i.e., relative inability to change the characteristics of activities).

In the container terminal market it seems that the left part of Figure 3.2 holds true. Risks for private companies to invest huge amounts of money in container terminals are high, due to the long expected economic life of infrastructure. This may range from 20 years to more than a century. The pay-back period of infiastructure investments is also long; usually around 15 to 30 years. Private investments usually must generate profits in a far more restricted time period (e.g. 5-10 years). Secondly, the relatively low leve1 of the operational (variable) costs, imposes a fiirther risk increase for the private container terminal investor. Thirdly, during the construction time, a large amount of capita1 is required. Often high loans have to be acquired and the govemment is usually better able to attract cheaper loans (i.e., lower interest rates). Fourthly, the waiting period prior to actual infiastructure construction can be very long due to politica1 decision making. These formalities often lead to project changes that have a major influence on the costs of projects. In general, private companies are not willing to run these

politica1 risks, which forms another reason for govemment intervention. Fifthly, the irreversibility of the investment once the project has started causes another risk for private parties. If the construction is discontinued, this would lead to a significant capita1 loss, and this is another reason for govemment intervention to reduce the initial risks. Sixthly, the long construction period during which there are no revenues, imposes a lùrther risk increase for private terminal operators. In the beginning there are already interest and other costs which calls for a governmental role. Finally, each container terminal investment is more or less unique. This makes it difficult to learn from mistakes made in the past. Overall, govemments probably step into container terminal investment to decrease the risks for the private terminal operator. Without govemment intervention the risks of container terminal investments are relatively high compared with the low expected rates of return on investments.

Despite these risks, private involvement in financing and operating container terminals in harbours appears strong compared to other investments in transport infrastructure such as roads and railways. Public Private Partnerships (PPP) is a well-known term in this respect. Compared with investments in road and rail projects, Public Private Partnerships are often used for container terminals. In general, the (public) port authority is the provider of the suprastructure, whereas the private company operates the container terminal service portfolio. The construction of the terminal also involves financial aid of port authorities (e.g. through leasing constructions). The construction of a bulk terminal in the port of Amsterdam (starting in 1997) is a good example of this. The private company "Waterland Terminal" operates a terminal in Amsterdam, which is pre-fïnanced by the Gemeentelijk Havenbedrijf Amsterdam (GHA, port authority of Amsterdam). Banks were not interested, as it would be too risky for them. The terminal is paid back via a rent-buy construction (not a subsidy). Besides this, GHA also provided quays and land, which are rented by Waterland terminal. It seems that the same problem holds true for investments in container terminals. Banks are not interested or only when the pay-back period is less than ten years. Involvement of govermnental bodies enables a reduction of the pay-back period to 15-20 years which makes the project financially feasible. According to Farrell (1999) there are several reasons why ports have been more successful than other modes of transport in attracting private capital:

- There was an earlier recognition of the distinction between infrastructure and services. Port infrastructure is subsidised in most European countries, allowing service providers to make healthy profits at prices that are perceived as reasonable by their customers. The assignment of infrastructure to terminal operators in large blocks – which is quite unlike the 'open access' stevedoring arrangements found in some other parts of the world – has restricted competition from new entrants and protected monopoly profits (an opposite position is faced by the railways).
- The second reason for private sector interest in container terminals is the labour productivity gains in recent years, and the steady fall in unit costs due to economies of scale, which have not always been passed on to container terminal (port) users through lower tariffs. Private operators taking over the management of a public facility have usually been able to improve on past profit levels through the introduction of more flexible labour practices. The limited supply of terminals suitable for leasing and the high costs of building new infrastructure allow these profit levels to be maintained. Moreover, inside most container ports there is only one container terminal operator, which suggests the existence of regional monopolies.
- Furthermore, most container terminals involve relatively low risks after govemment intervention. The amounts of private investment required are still relatively smal1 in comparison with other transport modes – the suprastructure for a two berth container terminal costs around ECU 50-100 million, which is equivalent to only 10-20 km of motorway. Most of the assets are mobile, with well developed second hand markets. Private investment in container terminals is therefore not such a leap in the dark as it is in other transport modes.

- The final factor encouraging private investment is the relatively light regulatory framework. Container ports are perceived to operate in a highly competitive market, and do not offer a standard product. There has also been a convergence of interest between the private container terminal operators and their respective port authorities, united by their efforts to compete against other container ports.

The main issues in involving private finance for transport infrastructure investments, concerns the sharing of risk and ensuring higher efficiency. These are the main reasons that governments are interested in attracting private parties towards public infiastructure investment projects through long leasing contracts and operational involvement. In general, in infrastructure investments the flow of revenues often begins many years after the initial investment; this increases uncertainty and risk for a private party or consortium compared to altemative investment options. In general, investments in infiastructure incorporate various risks for private parties. Currently, in the specific case of investments in container terminals these risks seem to be effectively shared between governmental bodies and private parties. The exact risk sharing depends on the lease contract both parties have agreed on. However, some genera1 statements on the various risk components can be given (see Table 4.1).

Table 3.2: Container terminal investment categories and investment risks

	Pay-back	Operational costs	Capital	Waiting	Irreversible	Construction	uniqueness
Political risk	G	G	G	G	G	G	G
Financial risk	G/P	G/P	G/P	G	G/P	G	G/P
Construction risk	G/P	G/P	G/P	G	G/P	G/P	G
Operational risk	P	G/P	P	G	P	G/P	P
Commercial risk	P	P	P	G	P	G/P	P

G = govemment, P = private party; in this case the terminal operator
Source: Wiegmans et al., 1999

In Table 3.2 we connected the genera1 characteristics of investments in infrastructure with the risk factors associated with investing in infrastructure. In general, the government runs the politica1 risk of all characteristics of the investment in a container terminal. The terminal operator is 'safeguarded' from this risk by the government. The financial risks are shared between the government and the private terminal operator through lease constructions. The govemmental body mainly carries the construction risks of the container terminal. The private terminal operator nms both the operational risk and the commercial risk. Besides reducing the risks mentioned above for private container terminal operators, the govemmental body (port authority) can realise public benefits as well:

- With the construction of a new container terminal a city will receive more seaport tariffs and an increase in employment. These (fmancial) benefits are ***extra benefits*** above the amount resulting from the lease of the terminal facilities. In case of a road or railway there are in genera1 no extra long-term benefits for the govemment;
- In a port it is possible to create more terminal facilities and thus to favour ***competition*** in that particular harbour. In case of a road or railway this is not possible;
- In general, a container terminal has to compete with container terminals in other harbours for transhipment volume (***inter-port competition***). In the case of a road or railway there is often no serious altemative (regional monopoly);
- Both the Port Authority and the terminal operator have the ***same*** interest (creating or maintaining an excellent port). In case of a road or railway the main interest of a government seems to get part of the project financed by private parties, whereas private parties are interested in making profits out of that particular project.

In general, container terminal investment and PPP carries extra benefits compared with road and rail investment for both private terminal operators and governmental bodies.

4. The relation between risks, profits, and Public Private Partnerships

Public Private Partnerships in container terminal investments (both maritime and continental terminals) are operational and successful because it is possible to share risks and because the projects provide profits for both the government (through extra port tariffs) and for the terminal operator (through regular container transshipment). Currently, container terminals are normally operated on a common-user basis, and have different characteristics (Farrell, 1999):

- Terminals have been transferred to the private sector as leasehold concessions rather than privately built installations;
- Because container terminals have high capita1 costs, most ports can support only one operator – even where traffic is sufficient to support 2-3 competing operators, there may be collusion in the way the market is shared;
- Customers are shipping lines rather than tramp services making them more responsive to quality of service than to price;
- Container lines have a greater choice of ports than bulk shippers and are more mobile, leading to fierce inter-port competition.

Lately, we have seen the development of the first single-user container terminals in Europe (e.g. P&O, Antwerp, Euromax, Rotterdam). Due to the increasing scale of container carriers and the continuing development of the conferences (cooperation between a number of carriers), volume seems sufficient to justify single-user terminals providing just the services as they are needed (See also Benacchio et al., 2000).

A distinction has to be made between different cost elements of container terminals to be able to provide insight into the sharing of risks and profits. We investigated each cost component in order to be able to provide insight into the costs per container and the costs per Twenty-feet Equivalent Unit (TEU) for smal1 continental container terminals (see Appendix). These cost figures give some insight into the cost structure of an investor in container terminals. Based on this information we tried to compose a figure similar to Figure 1. Figure 3.4 presents a short term investment situation where it is profitable for a private company to invest in a terminal. It should be noted that this figure is only valid under certain assumptions. We assume a public private partnership between the private party and the port authority. As a consequence investment costs are reduced via lease contracts (although the amounts of required private investments are already relatively small). From the above this appears to be a valid assumption. This results in a lower average total costs curve, which is below the average revenues curve. The variable costs per unit are not constant anymore. Price will be set at p_1 and the terminal operator will make a profit of pip $_2$AB. For this to be true we assume that the container terminal operator fixes a price at leve1 p_1 and that no price discrimination takes place. In this case it is interesting for private companies to invest in a terminal under these circumstances. However, in practice prices are subject to competitive powers of container carriers and will be lower than leve1 p_1.

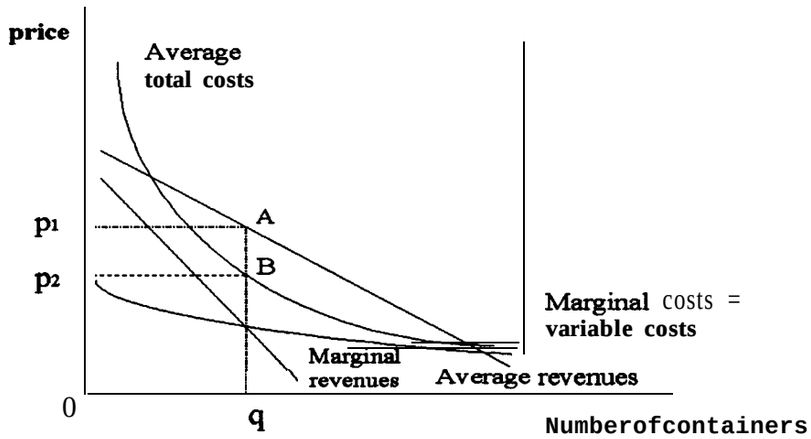

Figure 4.1: Market situation for an investor in terminals
Source: Nijkamp et al., 1995, adapted

Some remarks are in order concerning this analysis. The variable cost curve is almost vertical when the capacity of the terminal is not sufftcient anymore to handle all containers. More containers can only be transshipped when capacity is enlarged and all other measures to enlarge current capacity have been used (e.g. longer terminal operating hours, increase the number of cranes, employ more people, longer port operating hours, etc.). Besides, the situation above indicates that it is interesting for other companies to enter this container terminal market. New entrants lead to new cost structures and other equilibria. However, we focused on the short run situation for only one terminal operator in a certain port. The situation will be affected by new entrants within the same port or by new strategies of other competing ports. As a consequence this will affect pricing policies of the investor. But there has been a convergence of interest between the private operators and their port authorities, united by their efforts to compete against other ports (Farrell, 1999). This weakens the possible threat of competition. In addition, the economies of scale available to established operators puts them in a strong competitive position.
It may be clear that operating a terminal can be profitable and from this perspective interesting to private parties for investment. But it stil1 is without doubt that the role of port authorities should not be neglected. Differences in financial performance are not simply a question of some operators being more efficient than others, but are strongly influenced by government policy towards container terminal investment funding. For example, a contract to operate the terminal for 15 years results in a completely different financial figure compared to a lease period of 30 years. The cost structures of private terminals are also affected by the way port authorities attempt to recover infrastructure costs from port users, as they have a considerable amount of discretion in how they do this.

4. 1 Current practise in terminals investment in Europe

From a theoretical point of view, a container terminal can be developed in three ways: a new container terminal can be developed on a greenfield site, an existing container terminal can be extended, and an industrial site can be redeveloped into a container terminal. In container terminal investment projects we distinguish between four different categories of terminal investments:

1. **Infrastructure** investments consist of investments in rail, road, **barge,** and sea facilities to the terminal (terminal extemal and usually provided by the port authority). **Usage** is paid for through port tariffs;
2. Terminal **structure** investments consist of **specific** investments (e.g. quays, **cranes,** and **crane** rails) in terminal **infrastructure** (terminal intemal and usually partly provided by the port authority). **Usage** is paid for by the terminal operator through long term lease contracts;
3. Investments in the terminal suprastructure are investments on the terminal **site** that are not specifíc for a container terminal (e.g. terminal buildings, pavements, lightning, etc. and paid for by the terminal operator). **Usage** is paid for by the container terminal users through transshipment tariffs;
4. **ITstructure** investments are **all** information technology investments needed for the container terminal and are paid by the terminal operator. **Usage** is paid for by the container terminal users through transshipment tariffs.

In Table 4.2 we then turn to a number of cases in the Netherlands extended with some information of container terminals in other European countries in order to analyse Public Private Partnerships in **practice.** An overview is presented of some **core** variables of investments in container terminals.

Table 4.1 Investments in terminals in tbe Netberlands

Terminal Name	Location	Investment (€)	Capacity (TEU/year)	Main customers	Transpor tmode	Investment TEU (€)
Ceres Paragon Marine Terminal **(NT)**	**Amsterdam**	172 mln	**950.000**		**Deepsea**	180
Oosterhout (NT)	Oosterhout		**25.000**	**Ikea**	**Barge**	
Alphen aan de Rijn **(NT)**	Alphen	**22,5** mln		Heinekm	**Barge**	
IMCA (R)	**Amsterdam**	**22,5** mln	**150.000**		**Deepsea**	**150**
WCT (NT)	Vlissingen	550 mln	**2.500.000**	-	**Deepsea**	220
Valburg (NT)	Nijmegen	550 mln.	**1.400.000**		**Barge/rail**	**415**
Zeeland Container Terminal **(NT)**	**Terneuzen**	**31** mln	**100.000**	**Dow**	**Deepsea**	310
Beverwijk **(NT)**	**Beverwijk**	6mln	**40.000**	**Corus, Cargill**	**Barge**	**150**
Container Terminal regio Twente **(NT)**	Hengelo	**4,6** mln	22.500	**Grolsch Vredestein**	**Barge**	205
Wanssum (NT)	**Wanssum**	**10 mln**	-		**Barge**	
Container terminal Zutphen **(NT)**	Zutphen	7 mln.	**15.000**	**Addink/ Opijnen**	**Barge**	465
Moerdijk Container Terminal (E)	**Moerdijk**	20 **min**	**150.000**		**Deepsea**	**135**
Euromax Container Terminal **(NT)**	**Rotterdam**	525 mln.	**1.700.000**	**P&O Nedlloyd**	**Deepsea**	310
Shell Haven **(R)**	**London**	835 mln.	**3.500.000**	-	**Deepsea**	240
Trinity Container Terminal (E)	Felixstowe	**114 mln.**	**500.000**		**Deepsea**	230
Container Terminal Deurne **(NT)**	Deurne	4.9 mln	-	**Gosselin** Moving	**Barge**	
CTIV (NT)	**Bremen**	**260** mln.	-		**Deepsea**	-
Containerterminal Duinkerken (E)	Duinkerken	**15** mln.	-	-	**Deepsea**	-
Harwich Container Terminal **(E)**	Harwich	**160** mln.	**1.700.000**	-	**Deepsea**	**95**
Southampton CT **(NT)**	Southampton	**860** mln.	-		**Deepsea**	
Riva Terminal **Wielsbeke (NT)**	**Wielsbeke**	5 mln.	**75.000**	-	**Barge**	70
Average		208	**912.000**	•	•	225

Container development plan: NT = New Terminal, E = Extension, R = Redevelopment
Source: Journal of **Commerce, Cargoweb** Newsletter, **annual** report of ECT **and** HHLG, and Nieuwsblad Transport, 1999 **and 2000**

We observe that the total investment amount varies between 860 mln. and **4,6** mln. Euro. It is important to note the **difference** between continental terminals (capacity usually under 100.000 **TEU)** and maritime container terminals (capacity mainly over 100.000 **TEU).** Terminal capacities are varying between 15.000 and 3.500.000 **TEU** a year in these cases. **Almost all** terminals are either **barge** oriented or deepsea oriented. Initial investment **costs** vary between 135-465 Euro per **TEU.** Unfortunately, it is for most terminals impossible to **provide** detailed information on **cost categories,** lease contracts, capacity **usage,** and **cost/TEU.**

Table 4.2 Investments in terminals in Europe and public-private partnerships

Terminal Name	Investment amount (€)	Public Investment	Private Investment	Caprcity (TEU)	Public-Private Partnership ratio (%)
Ceres Paragon Marine Terminal	172 mln	128,5 mln.	43,5 min.	950.000	75-25
Oosterhout			-	25.000	
Alphen aan de Rijn	22,5 mln				
IMCA	22.5 mln			150.000	
WCT	550 mln.			2.500.000	
Valburg	550 mln.			1.400.000	
Zeeland Container Terminal	31 mln	17 mln.	14 mln.	75.000	55-45
Beverwijk	6 mln	1,4 mln.	4,6 mln.	-	23-77
Container Terminal regio Twente	4.6 mln	2,8 mln.	1,8 mln	22.500	60-40
Wanssum	10 mln				
Container terminal Zutphen	7 mln.			15.000	
Moerdijk Container Terminal	20 mln		-	150.000	
Euromax Container Terminal	525 mln.	300 mln.	225 mln.	1.700.000	57-43
Shell Haven	835 mln.			3.500.000	
Trinity Container Terminal	114 mln.			500.000	
Container Terminal Deurne	4,9 mln				
CTIV	260 mln.				
Containerterminal Duinkerken	15 mln.	9 mln	6 mln		60-40
River Terminal Wielsheke (NT)	5 mln.	2.4	2.6	75.000	48-52
Harwich Container Terminal				1.700.000	
Southampton CT	860 mln.				
Average	208 mln.	**66 mln.**	43 mln.	**912.000**	**55-45**

NT = New Terminal, E = Extension, R = Redevelopment
Source: Journal of Commerce, Cargoweb Newsletter, annual report ECT and HHLG, and Nieuwsblad Transport, 1999 and 2000

We observe that the Public-Private ratio varies between 23-77 for the container terminal in Beverwijk and 75-25 for the Ceres Paragon Marine Terminal in Amsterdam. Almost all container terminals are Public Private Partnerships in which the govemment contributes considerable amounts to the financing of container terminals. Due to a lack of data only a genera1 overview can be presented here. In the next section we will look in more detail to three of the container terminal investment projects and special attention is paid to the investment components conceming a new container terminal, an extension of an existing terminal, and the redevelopment of an existing site.

4.2 Three terminal case studies and Public Private Partnership

We selected three cases to be better able to look into detail into investment components and the differences between the development of a new container terminal (Ceres, Amsterdam), the redevelopment of an existing site (Shell Haven, London), and the extension of an existing container terminal (Port of Felixstowe, Felixstowe).

Ceres Paragon Marine Terminal Amsterdam

The terminal in Amsterdam is a joint project of Ceres Terminals Inc. and the Port Management of Amsterdam. Total investment is estimated at 172 million Euro and the terminal will be fully operational by mid 2001. Total extra employment is estimated around 600. Ceres Terminals Inc. will invest 43.5 million Euro (terminal buildings) and the Amsterdam Port Authority invests 128.5 million Euro in infrastructure and part of the cranes. Recently, the contract for all construction activities (such as berth dock, quay walls, paving, lightning, fencing, drainage, electrical systems, and other subsoil infrastructure; rail terminal and crane rails) has been awarded for 4 1 million Euro.

Port of Felixstowe (United Kingdom)

The container terminal in Felixstowe is a joint project of Hutchison Whampoa and the Port Management of Felixstowe. The current terminal consists of 540 acres and an additional 250 acres for which a long term lease is granted. The expansion plan has a two year time path and

will add about 500.00 TEU in extra transhipment capacity. Total investment is estimated at 114 million Euro. The expansion plan includes a quay extension of 270 meter and an additiona125 acres. The extra quay will be capable of serving two extra container ships. The three extra cranes are capable of serving ships up to 20 containers -and maybe even 22– wide on deck. Included in the investment amount is the transhipment equipment. The current terminal is studying on adding transhipment equipment worth 34 million Euro's as well. This amount will probably be paid for two quay cranes and ten rubber-tyred gantry cranes. The 26-km long charme1 has just been dredged to a depth of handling ships with a draught up to 15 meters (high tide). The dredging has last 70 weeks and has cost around 46 million Euro.

P&O Shell Haven Container Terminal (Turrock, Essex)

P&O and Shell will redevelop this former refinery site into a container port of 3.5 million TEU when fully developed. The site will consist of 1,500 acres of land, 3,000m of quays providing berths for up to ten vessels. The surrounding area will be developed to provide services like transport and logistics. P&O will purchase the land required and the site will be jointly developed with Shell. The Port of London Authority and Thurrock Council form part of the proposed deal to develop the site. Currently, the site is well connected by road and rail to the UK national network, but the capacity of these connections will be increased. The total investment is thought to exceed over 835 million Euro over the next 10-15 years. The terminal will be built in stages and the first phase -ready in 2003 or 2004– will cost around 167 million Euro.

If we take a closer look at the different container terminal development models we come to the following Table 4.3. This Table shows the relation between container terminal development types and risks of investments in infrastructure.

Table 4.3: Container terminal types and characteristics of investments in infrastructure

	Amsterdam	Felixstowe	London
Political risk	G	G/P	None
Financial risk	G/P	G/P	G/P
Construction risk	G/P	G/P	G/P
Operational risk	P	P	P
Commercial risk	P	P	P

G = govemment, P = private party; in this case the terminal operator
Source: Wiegmans et al., 1999

Considering the three case studies and the risks involved in investments in container terminals we constructed Table 4.3. In all three cases we observe that the private terminal operator runs the commercial and the operational risk. Financial and construction risks are shared in all three cases. The degree of risk sharing depends on the lease contract conditions. In the case of a completely new terminal we see that the govemment runs most of the politica1 risk, whereas in the case of an extension of a container terminal (e.g. Felixstowe) the politica1 risk is shared. Both the govemment and the terminal operator support the extra investment and try to secure the politica1 support. In the case of the redevelopment of an existing site (a former oil refinery in the case of London), the politica1 risk is of far less importance, since all parties are eager to transform such a site into a more productive area (e.g., a container terminal).

5. Conclusion

In general, it is stil1 not attractive to invest in transport infrastructure for private investors. This is mainly due to some specific risks and costs caused by several characteristics (public good) of transport infrastructure. Private involvement in fmancing and operating container terminals in harbours is high compared to other investments in transport infrastructure such as

roads and railways. Both the literature and also practice (number of PPP in container terminal investing) show that this statement holds largely true. In analysing investment projects of container terminals we find that in all projects both the govemment and private parties play a role. In general, container terminals are an example of a successful cooperation between government and business. It needs to be stressed however, that without govemmental help risks are stil1 too high in relation to the expected returns on investment for private parties. This has to do with the fact that costs of infrastructure are rather large for private companies. It appears that public funding via lease structures is necessary to reduce investment costs and to make the operation of a terminal a more attractive (profitable) activity.

Besides, the confirmation of the high involvement of private parties in container terminal investment projects, we have also identified the particular issue why terminals are more attractive to private investors than other infrastructure investment projects. Firstly, there was an earlier recognition of the distinction between container infrastructure and container services. Port infrastructure is subsidised in most European countries, allowing container terminal service providers to make (healthy) profits at prices, which are perceived as reasonable by their customers. Usually rail and road service providers do not make healthy profits and their users perceive prices as too high. It can even be stated that profits of container terminals are paid for by the tax-payer. Secondly, the assignment of infrastructure to terminal operators in large blocks – which is quite unlike the 'open access' stevedoring arrangements found in some other parts of the world – has restricted competition from new entrants and protected monopoly profits (a position that is a contrast with the railways).

The third reason for private sector interest in ports is the productivity gain in recent years, and the steady fall in unit costs due to economies of scale, which have not always been passed on to port users through lower tariffs. Private operators taking over a public facility have usually been able to improve on past profit levels through the introduction of more flexible labour practices, while the limited supply of terminals suitable for leasing and the high costs of building new infrastructure allow these profit levels to be maintained.

Furthermore, most port terminals involve relatively low risks after government intervention. The amounts of private investment required are still relatively smal1 in comparison with other modes – the suprastructure for a two berth container terminal costs around ECU 50-100 m, which is equivalent to only 10-20 km of motorway. Most of the assets are mobile, with well developed second hand markets. Private investment is not such a leap in the dark as it is in other transport modes. Or to put it another way, the chance for profits is higher to investments in container terminals than to conventional investments in infrastructure.

A fifth reason can be found in container terminal operations. These are becoming too complicated for cities and regions to perform as a govemmental task. Moreover, operation of a container terminal is definitely no core business of govemments.

The final factor encouraging private investment is the relatively light regulatory framework. Ports are perceived to operate in a highly competitive market, and do not offer a standard product. There has also been a convergence of interest between the private operators and their port authorities, united by their efforts to compete against other ports.

Rationality (extra employment, seaport tariffs, involvement in networks, etc.) for local govemments to invest in container terminals has vanished in recent years. Governments should be much more careful in these bidding processes for transshipment capacity. Competition between (in general) public port authorities for container terminal transshipment capacity leads to high risk situations for local governmental bodies.

Literature

Benacchio, Cariou, and Haralambides, **Dedicated container terminals: costs and benefits from** a port **perspective,** Special Interest Group on Maritime Transport and Ports, International workshop, Genoa, June **8-10, 2000**

Cargoweb Newsletter, **newsletter@cargoweb.nl,** Copyright 1999-2000 **Cargoweb** bv, The **Cargoweb** Newsletter is an independent source for logistic news

CBS, **Prijsindexcijfers,** Divisie Sociaal-Economische Consumentenprijsindexcijfers, Den Haag, 16-03-98

CERES Amsterdam Marine Terminals BV, **Annual Report** 1997, Amsterdam, 1998

Dietrich, M., **Transaction c[redacted]s and beyond: towards a new economics of the firm,** Routledge, London, 1994

ECMT (European Conference of Ministers of Transport), **Private and Public [redacted]ent in Transport,** Paris, 1990.

European Combined Terminals, **Annual Report** 1997, Rotterdam, 1998

European Combined Terminals, **Annual Report** 1998, Rotterdam, 1999

Farrell, S., **Financing European Transport Infrastructure,** Macmillan Press, London, 1999.

Fukuyama, F., **The end of history** of **the last man.** Free Press, New York, 1992.

Hall, P., **Great P[redacted]ing Disasters Revisited**, Department of Geography, University College, London, 1990.

Hamburger **Hafen-** und Lagerhaus-Aktiengesellschaft, **Bericht** des **vorstandes über das geschäftsjahr 1997,** Hamburg, 1998

Henry, C., **Public** Service **and Competition in the Community Approach** to **Communications Networks ,** paper Ecole Polytechnique, Laboratoire **d'Econometrie,** Paris, 1993.

Hilferink, P.B.D., **Kwaliteitseisen aan terminals,** Intermodaal: op welke schaal? De functie van kleinschalige knooppunten in het Europese netwerk, (ed. D. Strijker), **p.79-94,** Stichting Ruimtelijke Economie, Groningen, 1994

Inamura, H., Ishiguro, K., and M.A.. **Osman, Asian Container Transportation Network and its Effects On th[redacted]ese Shipping Industry, IATSS** Research, Vol. 21. No. 2, 1997, **p.100-108**

ITS (Institute for Transport Studies) and partners, **Project Fatima,** project funded by the European Commission, Brussels, 1999.

Journal of **Commerce, JoC Online,** 33 Washington Street, Newark, NJ, Copyright 1999-2001, The **Journal** of **Commerce**

Klink, H.A., van, **Towards** the **borderless mainport Rotterdam,** Rotterdam, 1995

Nieuwsblad Transport, **Nieuwsblad Transport, Antwoordnummer** 5528 3000 VB Rotterdam, Copyright 1999-200 1, Nieuwsblad Transport

Nijkamp, P. and S.A. Rienstra. **Private sector involvement in financing and operating transport infrastructure, Annals** of Regional Science, 29, pp. 22 1-235.

Nijkamp, P, B. Ubbels and M. Koetse, Infrastructuur als portfolio: een duurzaamheidsvisie op infrastructuur, Delft University Press, Delft, 2000.

Rienstra, S.A. and P. Nijkamp, Lessons from private financing of transport infrastructure, Revue Economique, 48 (2), pp. 23 1-245.

Societa per Azioni, Major European container terminals structure and performance report 199 1, Societa per Azioni, Genova, November 199 1

TU Delft, Intermodhaalbaar, een verkennend onderzoek naar de haalbaarheid van gecombineerd weg-watervervoer voor containers in de randstad, Delft, December 1995

Wiegmans, B.W., Masurel, E., and P. Nijkamp, Intermodal freight terminals: an analysis of the terminal market, Research memorandum 1998-55, Vrije Universiteit, Amsterdam, 1998

Wiegmans, B.W., Nijkamp, P., and E. Masurel, Intermodal freight terminals: marketing channels and networks, Research memorandum 1999-12, Vrije Universiteit, Amsterdam, 1999